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Executive Summary

After extensive consultations with key Russian officials and scientific leaders and drawing on the experience gained through the initiation of six pilot projects at two Russian facilities to investigate the practical aspects of cooperation, the National Academy of Sciences Committee on U.S.-Russian Cooperation on Dangerous Pathogens recommends a five-year Pathogens Initiative, *followed by a second phase of sustained joint U.S.-Russian research and related efforts. The program will support collaboration on the epidemiology, prevention, diagnosis, and therapy of diseases associated with dangerous pathogens that pose serious public health threats, as well as related fundamental research. The* Pathogens Initiative *will engage a substantial number of highly qualified specialists from the former Soviet biological weapons complex and will serve important U.S. national security and public health goals.*

CONTEXT

Rapid advances in the biological sciences and biotechnology hold the promise of dramatically improving human health, agriculture, and other aspects of life. The broad diffusion of knowledge and capabilities enables many countries to benefit from these advances.

The spread of biotechnology, however, is also accompanied by significant risks. The capabilities associated with research on dangerous human, animal, and plant pathogens represent a complex dual-use technology; some of the knowledge of medicine, agriculture, and biotechnology overlaps with the knowledge necessary to use pathogens for hostile purposes. In addition, some equipment and facilities are versatile. Certain types of vaccine facilities, for example, could be converted to produce biological agents for use by military forces or terrorists.

The international community has responded to the threat of biological weapons (BW) by constructing an international regime—based on the Geneva Protocol and the Biological Weapons Convention (BWC) and supplemented by the Australia Group's export control guidelines—to ban their use, development, stockpiling, and production and to prevent countries and subnational groups from acquiring them. Activities focused on a particular country, such as Iraq, also are part of the international effort to forestall or respond to the proliferation of BW.

The BWC, however, lacks verification provisions and contains only limited procedures for addressing a suspected violation. Achieving a broad consensus on strengthening the international regime in this critical area is impeded by a number of factors, not least of which is a deep-seated lack of trust between Western countries and Russia concerning BW-related activities. In 1992, Russia acknowledged that the Soviet Union had maintained a BW program involving activities that violated the BWC, thereby confirming long-standing Western suspicions. At that time, President Yeltsin declared that illegal activities had ceased and future work in violation of the BWC was prohibited, but the Russian government has been unable to convince the United States that Russia is now in complete compliance with its treaty obligations.

Adding to these uncertainties is the sheer size of the former Soviet BW complex, which Russia is finding difficult to maintain financially, whatever the intended purpose of the facilities may now be.

Although in disrepair in many respects, this complex remains, raising fears in the West that dangerous materials, equipment, and know-how could be misused or could leak to parties of proliferation concern. Encouraging Russia to reconfigure some of these facilities to carry out peaceful work on dangerous pathogens and to convert the others to peaceful use not connected with dangerous pathogens is thus an important aspect of U.S. nonproliferation policy.

THE IMPORTANCE OF U.S.-RUSSIAN COOPERATION ON DANGEROUS PATHOGENS

Russia will undoubtedly continue to support legitimate research and related activities on dangerous pathogens. U.S. involvement in these activities through cooperative programs will provide opportunities to build confidence that prohibited research is not being pursued under the guise of legitimate undertakings. Also, from a public health viewpoint, Russian scientists who participated in former Soviet BW program have a unique knowledge of many aspects of naturally occurring pathogens as well as those that could be used by terrorist groups.

The committee believes that appropriately structured U.S.-Russian cooperation on dangerous pathogens—featuring direct laboratory-to-laboratory contacts and based on the principle of broad transparency—will serve the interests of both countries. Such cooperation could contribute significantly to the following objectives:

1. National security benefits
   - Providing greater mutual confidence about compliance with the BWC than would otherwise be possible
   - Reducing proliferation incentives
   - Serving as a stepping stone to dismantlement opportunities
   - Reconfiguring former Soviet BW-related activities
   - Enhancing capabilities to combat bioterrorism
2. Public health benefits
   - Improving understanding of the prevalence and characteristics of pathogens that pose threats to public health
   - Strengthening capabilities to prevent, diagnose, and treat outbreaks of infectious diseases
   - Enhancing international communications concerning disease trends and outbreaks
3. Economic benefits
   - Improving the stability of Russian research institutes by increasing the commercial viability of their research products
   - Leveraging limited national financial and human resources to serve national security public health
   - Providing new opportunities for the U.S. private sector to become more active in Russia
4. Scientific benefits
   - Enhancing the base of fundamental knowledge about pathogenesis
   - Increasing the international availability of research results.

Even the most extensive collaboration between Russian and U.S. scientists will not provide incontrovertible assurance that all research activities on dangerous pathogens are devoted to legitimate purposes. Recognizing this risk, the committee has concluded that, governed by appropriate rules of transparency, a cooperative program can be carried out in a manner to ensure that the risk of abuse of such a program is reduced to an acceptable level.

Expanded arrangements to provide sufficient transparency should include mutual agreement on a project-by-project basis concerning the activities that are legitimate; regular and agreed-upon access to

facilities, personnel, and information; and commitment to the principle that providing assurance is an active rather than a passive responsibility. Moreover, during the evaluation of any joint research project, its potential contributions to health and national security must be judged to outweigh the risk that the project might contribute to the development or improvement of offensive BW capabilities.

The committee recommends that the proposed program be undertaken in close coordination with related bilateral activities (see Table E-1).

Table E-1 Selected Organizations with Program Interests Related to the *Pathogens Initiative*

Organization	Description
International Science and Technology Center (ISTC)	This international organization, established by the United States, the European Union, Japan, and Russia, has supported a number of projects at a variety of institutes involved in the former Soviet BW program, including projects that address dangerous pathogens. ISTC has received dozens of other well-developed, but yet-to-be-funded proposals in this area. In addition, it has sponsored several symposia on related topics.
Initiatives for Proliferation Prevention (IPP)	This program of the U.S. Department of Energy recently announced its intention to support biotechnology proposals at Russian institutes, particularly Biopreparat institutes, that have potential for commercial markets. IPP has received dozens of proposals from a variety of Russian institutions, including proposals for research on dangerous pathogens.
U.S. Civilian Research and Development Foundation (CRDF)	This private foundation, established by Congress in 1992 and set up by the National Science Foundation in 1995, has solicited basic research proposals from interested Russian investigators in the biomedical field. CRDF currently supports eight projects at institutes that were part of the former Soviet BW complex. The future of additional competitions is subject to further funding.
National Aeronautics and Space Administration (NASA)	NASA has funded several projects at Biopreparat institutes in support of its space science activities. The future of these types of projects in Russia is uncertain.
Centers for Disease Control and Prevention (CDC)	The CDC has long-standing relationships with several Russian institutes, some of which participated in the former Soviet BW program. It has participated in activities in Russia supported by the U.S. Agency for International Development and frequently provides training for Russian scientists.
National Institutes of Health (NIH)	NIH provides grant supplements to its U.S. investigators to involve international scientists in their projects. NIH also provides training opportunities for international specialists in its laboratories. Russian researchers who participated in former Soviet BW activities can apply to these programs.
U.S. Department of Agriculture (USDA)	The USDA supports a limited number of biotechnology projects in Russia that are directly linked to agriculture development. Its current Russian portfolio does not include research on dangerous pathogens.

ESTABLISHING THE BASIS FOR EXPANDED COOPERATION

The committee's consultations with a range of Russian officials, research managers, and laboratory scientists helped ensure that assessments of the technical basis for cooperation were authoritative and realistic. In addition, these interactions resulted in Russian specialists, acquiring a sense of genuine partnership in the development of the recommended program. Consultations included scientific visits to Russian research institutes in Koltsovo and Obolensk, where pilot projects were later established; one round of consultations and two joint planning meetings in Moscow; and an international symposium in the Kirov region involving 30 Russian specialists, sponsored by the National Academy of Sciences (NAS) and the International Science and Technology Center (ISTC).

Of particular importance is the reported endorsement by the Russian Defense Council of the NAS initiative. Such support would be critical to the future success of a cooperative program involving defense scientists.

Biopreparat—an organization originally established by the Soviet government to provide a wide range of BW-related research, production, and support services—was the principal point of contact in Russia for the NAS committee. Specialists from many Biopreparat facilities and other Russian organizations participated in these consultations.

The committee was not successful in its efforts to meet with specialists from the Russian Ministry of Defense (MOD), but efforts to engage MOD should continue. Several Russian officials have expressed optimism that MOD will eventually participate in bilateral cooperative activities, either directly or in partnership with Biopreparat institutes. Although MOD participation is highly desirable, the Biopreparat complex provided much of the critical research and development support for the Soviet program; thus, the committee believes that cooperation with Biopreparat in and of itself will make a valuable contribution to achieving the benefits mentioned above.

In parallel with these consultations, the committee initiated six pilot projects at two Russian facilities and is developing two more (see Box E-1) to gain experience conducting collaborative research projects. The projects have contributed useful insights at the scientist-to-scientist level into the capabilities of the two countries. The pilot projects also were important in convincing Russian colleagues that the NAS undertaking was a serious endeavor with strong backing from the U.S. government, thereby encouraging them to participate actively in planning a long-term program.

Box E-1 Pilot Projects Initiated by NAS and Financed by DOD

The following projects were under way as of July 1997, with funds committed to Russian institutions[a]:

At the State Research Center for Virology and Biotechnology, "Vector," Koltsovo

- Study of prevalence, genotype distribution, and molecular variability of isolates of hepatitis C virus in the Asian part of Russia; $55,000; principal investigator, Sergei Netesov; collaborator, Elizabeth Robertson, CDC; ISTC 883
- Monkeypox virus genome; $55,000; principal investigator, Sergei Shchelkunov; collaborators, Peter Jahrling, USAMRIID, and Joseph Esposito, CDC; ISTC 884
- Study of the genetic and serologic diversity of hantaviruses in the Asian part of Russia; $55,000; principal investigator, Lyudmilla Yashina; collaborators, Connie Schmaljohn, USAMRIID, and Stuart Nichol, CDC; ISTC 805
- Development of advanced diagnostic kit for opisthorchiasis in human patients; $55,000; principal investigator, Valery Loktev; collaborator, Victor Tsang, CDC; ISTC 691

At the State Research Center for Applied Microbiology, Obolensk

- Molecular-biological and immunochemical analysis of clinical strains of tuberculosis and mycobacteriosis; $138,000; principal investigator, Igor Shemyakin; collaborator, Thomas Shinnick, CDC; ISTC 810
- Investigation of the immunological effectiveness of delivery *in vivo* of the *Brucella* main outer membrane protein by the anthrax toxin components; $61,500; principal investigator, Anatoly Noskov; collaborators, John Collier, Harvard University, and Arthur Friedlander, USAMRIID; ISTC 919

The following projects were being processed by ISTC as of October 1997:

At the State Research Center for Virology and Biotechnology, "Vector," Koltsovo

- Experimental studies of antiviral activities of glycyrrhyzic acid derivatives against Marburg, Ebola, and human immunodeficiency virus; principal investigator, Andrei Pokrovsky; collaborator, John Huggins, USAMRIID.

At the State Research Center for Applied Microbiology, Obolensk:

- Monitoring of Anthrax; principal investigator, Nikolai Staritsin; collaborator, Arthur Friedlander, USAMRIID.

NOTE: CDC = Centers for Disease Control and Prevention; DOD = Department of Defense; USAMRIID = U.S. Army Medical Research Institute of Infectious Diseases.

[a] Funds committed to U.S. collaborating institutions are CDC, $47,000; USAMRIID, $20,000; Harvard University, $9,000.

The NAS committee used the following criteria in selecting the pilot projects:

- Scientific importance of the topic;
- Quality of the proposal;
- Quality or capacity of the principal investigator, research team, and facilities;
- Provision for strong U.S. collaboration;
- Engagement of former Soviet BW expertise; and
- Promotion of transparency.

The committee also made the judgment that each project's potential contributions to public health or U.S. national security interests outweigh the risk that the project might contribute to the development or improvement of offensive BW capabilities.

The pilot projects were limited efforts, and the committee concluded that the following additional criteria should be considered in the selection of projects within the larger program recommended in this report:

- Likelihood of sustaining the research by attracting the interest of other organizations with financial capabilities to continue work in the general field after completion of the project and
- Promotion of linkages between Russian scientists working in institutions that had been involved in BW activities and those that were not involved in such activities.

The committee also strongly recommends that if future joint activities are pursued, U.S. specialists should adopt a more proactive role in identifying possible research topics and proposals for funding. The framework for collaboration presented in this report is designed to promote this goal.

The NAS became a partner of the ISTC in Moscow, which provides an important administrative framework for processing and reviewing proposals, monitoring projects, and dispensing funds within Russia. Of special importance are ISTC procedures for distributing funds for salaries directly to individual researchers, thereby circumventing opportunities for intermediaries to divert a portion of the funds for unintended uses.

Drawing on this first-hand experience, the committee developed three overarching principles for guiding bilateral activities:

1. Projects should be collaborative in design and conduct.
   - Only projects that are of interest to specialists in both countries should be undertaken.
   - All projects should be conducted on the basis of cooperation, not assistance, with each side making intellectual, financial, and in-kind contributions.
   - All relevant constituencies in both countries should be able to apply for participation in the program.
2. Projects should be designed and conducted in a way that maximizes transparency.
   - Activities should be carried out in an environment of openness.
   - Direct contacts among specialists should be stressed.
   - A central coordination point within each government should be apprised of cooperative activities.
3. Results of cooperative projects should be disseminated to the widest possible interested audience.
   - Whenever possible, research results should be promptly published or made available to international audiences through other channels.
   - Intellectual property and sensitive findings should be protected.
   - Intellectual property rights resulting from cooperative activities should be shared by the participating institutions on fair and equitable terms.

PHASE 1: A *PATHOGENS INITIATIVE*

Although Russian interest in cooperation in this field is increasing, the future political course in Russia remains difficult to predict. As cooperation becomes more ingrained in the Russian scientific community, joint efforts are more likely to survive political shocks, thus underscoring the importance of establishing and broadening cooperation while the window of opportunity is open.

The core of a *Pathogens Initiative* should be joint research projects directed to the epidemiology, prophylaxis, diagnosis, and therapy of diseases associated with dangerous pathogens as well as related fundamental research. According to Russian colleagues, if the U.S. government decides to support such an initiative, early intergovernment endorsement of the program could encourage MOD to participate. In addition, such political support could help resolve many policy, implementation, and budget issues confronting Biopreparat and other interested organizations in both countries.

The committee recommends seven program areas as the initial framework for the program. The first five areas—anthrax, melioidosis and glanders, plague, orthopox virus, and viral hemorrhagic fevers—are agents or diseases that have been linked with BW activities for many years. In each of these areas the Soviet government is believed to have invested substantial financial resources to carry out

research that is largely unknown outside that country. Organizations in the United States also have good research capabilities to help combat the infectious diseases of interest.

Two additional program areas will provide opportunities to address other pathogens or diseases of public health concern and to carry out related fundamental research. These two categories are particularly important in both providing support for key Russian scientists who are interested in pursuing careers not tied directly to potential BW agents and expanding the pool of potential collaborators in the United States.

A five-year program that builds to a level at which 15 three-year projects are initiated each year, involving an average of 10 full-time Russian specialists per project, could engage a substantial number of leading Russian specialists in the field and most of the key Russian research facilities. See Table E-2 for the phasing of collaborative research projects.

Table E-2 Phasing of Collaborative Research Projects

Task Name	1997 Y1	1998 Y2	1999 Y3	2000 Y4	2001 Y5	2002 Y6	2003 Y7	2004 Y8	2005 Y9	2006 Y10
Six pilot projects										
Two pilot projects										
Ten projects										
Twelve projects										
Fifteen projects										
Fifteen projects										
Fifteen projects										
Era of Sustained Cooperation										

Projects will be selected on a competitive basis by using the criteria set forth above. The resources devoted to each program area should depend on the quality of project proposals across all areas. The pilot projects fall into several areas, and the possibility of expanding these limited efforts should be considered if the results are promising.

Several supporting activities could effectively complement the research programs. Specifically, upgrading the communications capabilities of selected Russian institutes, improving the safekeeping and utilization of strain collections used as national reference standards, and expanding exchanges of information on biosafety requirements and practices are appropriate areas of cooperation.

In addition to annual reviews of all projects, the overall approach will be evaluated in depth at the end of the second year and adjusted as necessary.

PHASE 2: AN ERA OF SUSTAINED COOPERATION FOLLOWING THE *PATHOGENS INITIATIVE*

Recognizing that sustained cooperation must be accompanied by rules of disclosure and other measures designed to provide assurance that work is devoted strictly to legitimate purposes, the committee developed a model for progressive development of suitable transparency arrangements. The model is intended to emphasize the importance of transparency and to stimulate the official deliberations necessary to work out agreed-upon provisions. The model calls for an intergovernment mechanism to provide direction for collaborative efforts on a broad front.

Joint research projects would continue to be the core of long-term cooperation. Expanded cooperation in epidemiology and rapid response to outbreaks of infectious disease would promote trust between the two countries. Related to the expanded international exchange of data, the internal capabilities of Russia to assess and process epidemiologic information would have to be strengthened. During outbreaks of diseases, specialists from the two countries should collaborate in providing their

most relevant information and offering technical support to each other. Also, Russian specialists who are involved in field investigations should be encouraged to apply for participation in the training programs of the Centers for Disease Control and Prevention (CDC).

In addition, the promotion of effective national regulatory approaches to controlling dangerous pathogens appears to be essential to ensure responsible handling of these pathogens on a broad front. Effective enforcement procedures and sharing of experiences are particularly important in developing mutual trust.

At the same time, the need to prevent the dissemination of sensitive information to parties of proliferation concern and to protect intellectual property rights would continue to be important. The Russian and U.S. governments should adopt appropriate procedures to ensure that these issues are addressed in a manner that does not undercut the broader transparency objectives of cooperative endeavors.

COSTS

To build on current momentum, the committee recommends that the U.S. Department of Defense (DOD) promptly provide financial support for the *Pathogens Initiative*. Sustained funding for the longer-term Phase 2 program would undoubtedly require agreement between the executive branch and Congress about a line item in the budget of a selected agency. It is premature to speculate which department or agency should have long-term financial responsibility.

Pathogens Initiative

The projected costs to the United States of the *Pathogens Initiative* are as follows: fiscal year (FY) 1998, $6 million; FY 1999, $7 million; FY 2000, $8.5 million; FY 2001, $8.5 million; and FY 2002, $8.5 million. Most of these funds are earmarked for direct project support, as shown in Table E-3. When the *Pathogens Initiative* is fully developed in FY 2000, the costs will be $4.5 million (53 percent) for the Russian research teams, $2.5 million (29 percent) for the U.S. collaborators, $500,000 (6 percent) for project development activities, and $1 million (12 percent) for program evaluation, financial management, and related support activities.

Table E-3 Allocation of Funds per Fiscal Year During the *Pathogens Initiative* (in millions of dollars)

FY	Budget	New Projects	Total Projects[a]	Funds to Russian Research Teams	Funds to U.S. Collaborator	Funds to Project Management
1998	6.0	10	10	3.5	1.5	1.0
1999	7.0	12	22	4.0	2.0	1.0
2000	8.5	15	37	4.5	2.5	1.5
2001	8.5	15	42	4.5	2.5	1.5
2002	8.5	15	45	4.5	2.5	1.5

[a] This total does not include pilot projects.

Phase 2: An Era of Longer-Term Sustained Cooperation

As indicated above, it is assumed that the size of the program will grow steadily and then level off during the era of sustained cooperation. Under the model suggested as a goal for expanded efforts, the estimated annual costs to the United States beginning in FY 2003 are $5 million (50 percent) to support U.S. collaborators; $2 million (20 percent) to support selected aspects of Russian participation in activities of special interest to the United States; $1 million (10 percent) for project development,

evaluation, and related activities; and $2 million (20 percent) for support for the intergovernment mechanism and related specialized committees to oversee the entire activity. The total U.S. contribution would be $10 million per year and Russian institutions would be expected to cover most of their own costs.

ANTICIPATED RESULTS OF THE PROGRAM

The proposed joint efforts could build a considerable level of trust between the scientific communities of Russia and the United States in a way that would help change the tone of diplomacy on the international security aspects of dangerous pathogens. Such efforts could have profound effects–both direct and indirect–in reducing the threats of proliferation and terrorism. Also, the program will make many contributions to combating dangerous infectious diseases, while serving as a model for global efforts when the dangers of new and reemerging diseases are being recognized more fully in many countries.

One likely effect of such a multiyear program in Russia is a structural adjustment of its research enterprise dealing with dangerous pathogens. Research projects will be increasingly concentrated at a handful of the best institutions, which would become centers of excellence. To the extent that other institutions remain viable, they should be motivated to find work outside the area of dangerous pathogens.

Thus, there is a high probability this program will help achieve DOD objectives of nonproliferation and reconfiguration of the former Soviet BW complex into a less diffuse, less uncertain, and more public health oriented establishment.

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The Context for a Program of Bilateral Cooperation

THE DUAL-USE DIMENSION OF BIOTECHNOLOGY

As we approach the turn of the century, rapid advances in the biological sciences and biotechnology hold the promise of dramatically improving human health, agriculture, and other aspects of life. Although most discoveries and innovations have originated in the advanced industrial countries, broad diffusion of knowledge and capabilities provides the opportunity for other countries to use the results of these advances as well.

The spread of biotechnology, however, is accompanied by potential risks. The capabilities associated with research on dangerous human, animal, and plant pathogens represent a complex dual-use technology; some of the knowledge of medicine, agriculture, and biotechnology overlaps with the knowledge necessary to use pathogens for hostile purposes.[1] In addition, certain equipment and facilities are versatile; some vaccine facilities, for example, could be converted to produce biological agents for use by military forces or terrorists.[2]

Although under some conditions, biological weapons (BW) could in principle produce the same casualty levels as nuclear weapons of comparable weight, the feasibility of achieving these and other effects is far less certain. This uncertainty has led many experts to conclude that BW are generally unattractive, at least for traditional tactical military purposes.[3] However, the determined efforts of Iraq to develop a BW capability suggest that some countries may not share this assessment. An estimate by the Office of Technology Assessment (OTA) in 1993 named eight countries "generally reported as having an undeclared offensive biological warfare program."[4] In 1996, U.S. Arms Control and Disarmament Agency Director (ACDA) John Holum cited a dozen unspecified countries, noting that the United States believed this was twice as many countries as when the Biological Weapons Convention (BWC) entered into force in 1975.[5] In 1997 the U.S. Department of Defense Quadrennial Defense Review concluded that

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[1] For the purposes of this report, dangerous pathogens are defined as pathogens that are highly infectious, causing great concern to global public health. Of particular interest are pathogens that could be used in biological warfare.

[2] The *Journal of the American Medical Association* (JAMA) devoted an entire issue (vol. 278, no. 5, August 6, 1997) to the subject of biological warfare and bioterrorism.

[3] Office of Technology Assessment, U.S. Congress. 1993. *Proliferation of Weapons of Mass Destruction: Assessing the Risks*. Washington, D.C.: U.S. Government Printing Office, pp. 52-62; International Institute for Strategic Studies, 1997. *Strategic Survey 1996/1997*. London, p. 37.

[4] OTA, op. cit., p. 65. The countries were Iran, Iraq, Israel, Libya, Syria, China, North Korea, and Taiwan. To appear on the OTA list, a country must have been named in at least four of six major unclassified studies (five American and one Russian).

[5] U.S. ACDA, Washington, D.C. 1996. The Honorable John D. Holum, Director, Remarks to the Fourth Review Conference of the Biological Weapons Convention, Geneva, Switzerland, November 26.

"the threat or use of chemical and biological weapons (CBW) is a likely condition of future warfare, including in the early stages of war to disrupt U.S. operations and logistics."[6]

In addition to the risk of countries developing BW as an agent of war, there is growing concern that terrorists might add BW to their arsenals.[7] Terrorist use of biological agents could cause extensive casualties—and terrorists may not be as concerned about precision, predictability, and timeliness as regular military forces. Furthermore, a massive infrastructure is not necessary to create a deadly arsenal of these weapons.[8] To date, terrorist use has been confined to a few small incidents affecting a limited number of people. However, the efforts of the Aum Shinrikyo cult to master biological agents for broader use, although never fully realized, underscore the potential threat.[9]

Preventing, deterring, and responding to the risks posed by the availability of BW thus constitute a key security challenge facing the United States and the international community in the post-Cold War period.

INTERNATIONAL RESPONSE TO THE BW THREAT

The international community has responded to the threat of BW by constructing an international regime to ban their development, production, stockpiling, and use and to prevent countries and subnational groups from acquiring them. The 1925 Geneva Protocol prohibits the use of "bacteriological methods of warfare" as well as chemical weapons in war (see Appendix D for full text). Since the protocol bans only the *use* of bacteriological (biological) methods of warfare, a number of countries, including the United States and the former Soviet Union, developed offensive and defensive BW capabilities.[10] In 1969, however, President Nixon unconditionally renounced U.S. involvement in all methods of biological warfare, paving the way for negotiation of the 1972 BWC. (See Appendix E for full text.)

The BWC goes beyond the Geneva Protocol to ban the development, production, and stockpiling of bacteriological (biological) weapons and their means of delivery. Article X of the BWC explicitly permits research on and use of biological agents and toxins for peaceful purposes, acknowledging the fundamental dual-use dilemma. (The Treaty on the Nonproliferation of Nuclear Weapons and the Chemical Weapons Convention also contain provisions recognizing that nonproliferation measures should not deny parties to the treaty access to the peaceful benefits of technology.) Article X further declares that states parties "in a position to do so shall also cooperate in contributing individually or together with other states or international organizations to the further development and application of

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[6] U.S. Department of Defense (DOD). 1997. *Report of the Quadrennial Defense Review*. Washington, D.C.: DOD Office of Public Affairs, p. 13.

[7] See, for example, Kaufmann, A. F., Meltzer, M. L., and Schmid, G. P. 1997. The economic impact of a bioterrorist attack: Are prevention and postattack intervention programs justified? *Emerg. Infect. Dis.* 3: 83-94.

[8] Director of Central Intelligence. 1997. The Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, July-December 1996. Washington, D.C.: U.S. Government Printing Office, p. 3.

[9] Olson, K. B. 1995. Testimony to the Permanent Subcommittee on Investigations of the Senate Committee on Government Affairs, October 31, p.16. The Aum cult was unsuccessful in its attempts to develop and use effective biological agents; whether the group would have succeeded eventually cannot be known. See Kaplan, D. E. and Marshall, A. 1996. *The Cult at the End of the World*. New York, N.Y.: Crown Publishers.

[10] In addition, a number of countries, including the United States, did not promptly ratify the protocol. U.S. ratification of the protocol came in 1975 at the same time as its ratification of the BWC. The Soviet Union ratified the Geneva Protocol in 1928 and the BWC in 1975. See ACDA. 1990. *Arms Control and Disarmament Agreements: Texts and Histories of the Negotiations*. Washington, D.C.: U.S. Government Printing Office, pp. 15-18.

scientific discoveries in the field of bacteriology (biology) for prevention of diseases, or for other peaceful purposes."[11]

The BWC, however, lacks verification provisions and contains only limited procedures for addressing a suspected violation.[12] Conferences have been held every five years since 1981 to review the treaty's status and progress. In 1986 the Second Review Conference adopted a number of confidence-building measures, including exchanges of information about national capabilities and activities in BWC-relevant areas. In 1991 the Third Review Conference added more measures. See Box 1-1 for a list of the measures adopted in 1986 and 1991. The Third Review Conference also created an international group of technical experts to examine the scientific and technical possibilities for BWC verification.[13] As of mid-1997, an ad hoc group, in which all states parties to the treaty could participate, had begun negotiation of a legally binding verification protocol. Achieving a broad consensus on strengthening the international regime in this critical area is impeded by a number of factors, not least of which is a deep-seated lack of trust between the Western countries and Russia about BW-related activities. (The principal issues related to Russia are discussed in the next section.)

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[11] Ibid., pp. 133-138.

[12] In the event of a suspected violation, a state party to the convention can call for consultation among the states parties and suggest an appeal to the United Nations Security Council.

[13] Dando, M. R., and Pearson, G. S. 1997. The Fourth Review Conference of the Biological and Toxin Weapons Convention: Issues, outcomes, and unfinished business. *Politics Life Sci.* 16: 118-120.

BOX 1-1 Confidence-Building Measures Adopted by the Second and Third BWC Review Conferences (1986 and 1991)

A. Exchange of data on research centers and laboratories: Exchange of data, including name, location, scope, and general description of activities, on research centers and laboratories that meet very high national or international safety standards established for handling, for permitted purposes, biological materials that pose a high individual and community risk or specialize in permitted biological activities directly related to the Convention (1986).

B. Exchange of information on outbreaks of infectious diseases and similar occurrences caused by toxins: Exchange of information on outbreaks of infectious diseases and similar occurrences caused by toxins and on all such events that seem to deviate from the normal pattern as regards type, development, place, or time of occurrence. The information provided on events that deviate from the norm will include, as soon as it is available, data on the type of disease, approximate area affected, and number of cases (1986).

C. Encouragement of publication of results and promotion of use of knowledge: Encouragement of publication of results of biological research directly related to the Convention, in scientific journals generally available to States Parties, as well as promotion of use for permitted purposes of knowledge gained in this research (1986).

D. Active promotion of contacts: Active promotion of contacts between scientists, other experts and facilities engaged in biological research directly related to the Convention, including exchanges and visits for joint research on a mutually agreed basis (1986).

Modalities: In order to actively promote professional contacts between scientists, joint research projects and other activities aimed at preventing or reducing the occurrence of ambiguities, doubts, and suspicions and at improving international cooperation in the field of peaceful bacteriological (biological) activities, States Parties are encouraged to provide information, to the extent possible, on planned international conferences, seminars, symposia, and similar events dealing with biological research directly related to the Convention and on other opportunities for exchange of scientists, joint research, or other measures to promote contacts between scientists engaged in biological research directly related to the Convention (1991).

E. As an indication of the measures which they have taken to implement the Convention, States Parties shall declare whether they have legislation, regulation or other measures: a) to prohibit the development, production, stockpiling, acquisition or retention of microbial or other biological agents, or toxins, weapons, equipment and means of delivery, specified in Article I of the Convention, within their territory or anywhere under their jurisdiction or control; b) in relation to the export or import of micro-organisms pathogenic to man, animals and plants or of toxins in accordance with the Convention; States Parties shall complete the attached Form E and shall be prepared to submit copies of the legislation, or regulations or written details of other measures on request to the UN Department of Disarmament Affairs or to an individual State Party. On an annual basis States Parties shall indicate, also on the attached form, whether or not there has been any amendment to their legislation, regulations or other measures (1991).

F. In the interest of increasing transparency and openness, States Parties shall declare whether or not they conducted any offensive and/or defensive biological research and development programs since 1 January 1946. If so, States Parties shall provide information on such programs, in accordance with Form F (1991).

G. To further increase the transparency of biological research and development related to the Convention and to broaden scientific and technical knowledge as agreed in Article X, each State Party will declare all facilities, both governmental and non-governmental, within its territory or under its jurisdiction or control anywhere, producing vaccines licensed by the State Party for the protection of humans. Information shall be provided on Form G attached (1991).

Complementing Article III of the BWC, which prohibits transfer of items or assistance to any state, group of states, or international organizations in contravention of the BWC, many states have enacted national export control regulations. In an attempt to harmonize these regulations, some 30 states have entered into an informal coordination mechanism known as the Australia Group, which has developed lists of microorganisms and toxins, as well as equipment, that could be used for BW. These

lists are intended to help guide the national export control decisions of its members. (See Appendix F for the lists.)[14]

Activities focused on particular countries are another part of the international effort to forestall or respond to the proliferation of BW. At present, the primary case of country-specific action is Iraq, which remains subject to stringent UN-imposed sanctions and continuing inspections in the wake of revelations after the Persian Gulf War of its attempts to develop nuclear and biological weapons.[15] The United States also has made certain other countries a particular focus of its counterproliferation initiatives and has sought the cooperation of its allies to limit the access of these countries to weapons of mass destruction and their means of delivery.[16]

THE SPECIAL CASE OF RUSSIA

Russia is of special concern to the United States as a source of proliferation. When the Soviet Union collapsed in 1991, Russia inherited most of the vast Soviet military establishment. What remains exceeds anything that Russia can afford to maintain; this excess capacity has heightened concerns about the proliferation of dangerous materials, equipment, technical data, and know-how.

In the immediate aftermath of the Soviet collapse, U.S. concern focused on the safety and security of Soviet nuclear weapons. In response, Congress passed the Soviet Nuclear Threat Reduction Act (often referred to as the Nunn-Lugar Initiative) in late 1991 to provide a basis for U.S. cooperation with the former Soviet Union (FSU). Its primary purposes were to prevent proliferation of dangerous or potentially dangerous items and technology from the nuclear weapons complex of the FSU and to facilitate implementation of arms reduction agreements. The ensuing Cooperative Threat Reduction (CTR) program, administered by the Department of Defense (DOD), was designed to limit the proliferation potential of both weapons and technical experts. Thus, in addition to programs to secure weapons and material, the CTR program provided initial funding for the International Science and Technology Center (ISTC) as a means of redirecting former weapons scientists and engineers to new, peaceful research endeavors and promoting U.S. nonproliferation interests.[17]

The former Soviet BW program was also causing concern in the international community. In 1992, Russia acknowledged that the Soviet Union had maintained a BW program involving activities that violated the BWC, thereby confirming long-standing Western suspicions.[18] At its peak, the research and development component of the Soviet program supported basic research in both military and nonmilitary institutions to ensure the availability of fundamental knowledge and expertise; maintained a network of specialized research facilities, the Biopreparat complex, which was responsible for weapons-related research and production of agents as well as development and production of vaccines and other defensive

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[14] The Australia Group (AG) was originally created to foster consistent export controls related to chemical weapons; in 1990 the AG expanded its scope to include BW issues.

[15] Iraq had already developed and used chemical weapons (CW) both during its war with Iran in the late 1980s and on its own citizens. After the Gulf War, the Iraqi CW program was included in UN sanctions.

[16] See, for example, Perry, W. J., Secretary of Defense. 1996. *Annual Report to the President and Congress*. Washington, D.C.: U.S. Government Printing Office, pp. 53-59.

[17] National Research Council. 1996. *An Assessment of the International Science and Technology Center.* Washington, D.C.: National Academy Press.

[18] Hunger, I. 1996. *Strengthening the BWC: Key Points for the Fourth Review Conference*, Pearson, G. S. and Dando, M. R., eds. Geneva: Quaker United Nations Office, p. 84. See also text of an interview with General Anatoly Kuntsevich in *Rossiskiye Vesti,* September 22, 1992, and FBIS-SOV-92-186, September 24, 1992. See also text of an interview with President Boris Yeltsin in *Rossiskiye Vesti,* May 27, 1992, and FBIS-SOV-92-103, May 27, 1992.

measures; and maintained highly secret research and production facilities within the Ministry of Defense (MOD), about which relatively little is known.[19] Boxes 1-2 thru 1-4 list selected MOD, Biopreparat, and civilian institutions.

BOX 1-2 MOD Institutes with Biological Research Programs

1. Scientific Research Institute of Microbiology, Kirov[a]
   - Center for Virology, Sergiev Posad[a]
   - Center of Military-Technical Problems of Biological Defense, Yekaterinburg
2. Scientific Research Institute of Military Medicine, St. Petersburg

NOTE: For discussions of the activities of these institutes, see Rimmington, A. 1996. From military to industrial complex? The conversion of biological weapons' facilities in the Russian Federation. *Contemp. Security Policy* 17: 80-112.

[a] Participated in ISTC Symposium in Pokrov in 1996.

Source: Committee Discussions in Russia, 1997.

Box 1-3 Selected Biopreparat Institutes and Enterprises with Capabilities of Relevance to Dangerous Pathogens That Have Expressed Interest in International Cooperation

1. Research Institutes
   - State Research Center for Virology and Biotechnology, "Vector," Koltsovo[a,b,c,d]
   - State Research Center for Applied Microbiology, Obolensk[a,b,c,d]
   - Institute of Immunology, Lyubuchany[b,c,d]
   - Institute for Scientific Biological Instrumentation, Moscow[b,c,d]
   - Institute for Highly Pure Biopreparations, St. Petersburg[d]
   - Institute for Biochemical Engineering, Moscow[d]
   - Research and Design Institute for the Biotechnology Industry, "Biotin," Kirov[c,e]
2. Scientific or production complexes
   - Scientific Experimental and Industrial Base, Omutninsk[c,d,e]
   - Biologics Plant, Pokrov[c]
   - Scientific Design Institute and Factory of Biopreparations Complex, Berdsk[e]

NOTE: Sources of information on the declared interests of most of these institutions are ISTC reports of the Kirov and Pokrov symposia and the unrestricted summaries of proposals submitted to the ISTC. Biopreparat officials informed the committee in June 1997 that there are 47 facilities within its complex, including 11 research institutes. Many facilities not listed above are undoubtedly interested in international cooperation, but their capabilities related to dangerous pathogens are unknown to the committee.

[a] Participated in pilot projects initiated by the National Academy of Sciences (NAS).

[b] Member of Biopreparat working group on bilateral cooperation.

[c] Participant or exhibitor at international symposium in Pokrov (1996) or Kirov (1997).

[d] Proposals sent to ISTC.

[e] Indication of interest conveyed informally to NAS.

[19] Rimmington, A. 1996. From military to industrial complex? The conversion of biological weapons facilities in the Russian Federation. *Contemp. Security Policy* 17: 80. It should be noted that there is little unclassified information available from the U.S. government about the size and activities of the Soviet BW research and production complex.

Box 1-4 Selected Russian Civilian Institutions Having Experience with Dangerous Pathogens and Links with Former BW-Related Specialists That Have Expressed Interest in International Cooperation

1. Ministry of Health, including Russian Academy of Medical Sciences
- Central Epidemiology Research Institute, Moscow[a,b]
- Ivanovsky Institute of Virology, Moscow[a,b,c,d]
- Gamaleya Institute of Epidemiology and Microbiology, Moscow[b,d]
- Chumakov Institute of Poliomyelitis and Viral Encephalitides, Moscow[d]
- Tarasevich Research Institute of Standards and Control, Moscow[a,b]
- Institute of Immunology, Moscow
- Sechenov Academy of Medicine, Moscow[d]
- Scientific Research Institute for Vaccines and Sera, St.Petersburg[b]
- Research Center of Toxicology and Sanitary Regulation, Serpukhov[b]
- Plague Research Institute, Saratov[d,e]
- Plague Research Institute, Stavropol[d,e]

2. Russian Academy of Sciences
- Institute of Bioorganic Chemistry, Moscow[c]
- Institute of Gene Biology, Moscow[b]
- Institute of General Genetics, Moscow[b]

3. Ministry of Agriculture, including Academy of Agricultural Sciences
- All Russian Research Institute for Animal Protection, Vladimir[a]
- All Union Research Institute of Veterinary Preparations[a]

4. Other
- Volgo-Vyatka Applied Biotechnology Center, Kirov[a,e]
- Biysk Oleum Factory, Altai Region[b]
- Science and Technology Center Lekbiotech[b]
- Biotechnology Innovation Center, Serpukhov[b]

NOTE: This listing is not intended to be exhaustive, but it does cover most of the capabilities relevant to the *Pathogens Initiative.*

[a] Participant or exhibitor at international symposium in Pokrov (1996) or Kirov (1997).

[b] Proposals to ISTC.

[c] Leading role in previous projects with the National Academy of Sciences (NAS) related to dangerous pathogens.

[d] Member of Biopreparat working group on bilateral cooperation or participant in discussion in Petrovo-Dalnyee (1997).

[e] Interest in cooperation conveyed informally to NAS.

In 1992, Russian President Yeltsin issued a decree declaring that illegal activities had ceased and all future work in violation of the BWC was prohibited.[20] Despite this declaration, the Russian government has been unable to convince the United States that Russia is now in complete compliance with its treaty obligations.

In September 1992 the United States, the United Kingdom, and Russia signed a joint statement to create a mechanism for resolving lingering concerns and demonstrating the defensive nature of remaining Russian military capabilities in the BW area.[21] After initial reciprocal visits to selected facilities in each of the three countries, the governments were unable to agree on satisfactory arrangements for more extensive mutual visits or inspections. The Russian government has argued that the process also should serve to verify the legitimacy of U.S. and U.K. programs. Citing the lack of evidence of U.S. or U.K. noncompliance, the two governments reject this argument, maintaining that resolving the issue of

[20] Embassy of the Russian Federation, Washington, D.C. 1992. Decree of the President of the Russian Federation of 11 April 1992 (No. 390); and Rimmington, op. cit., p. 80.

[21] U.S. Department of State, Office of the Assistant Secretary/Spokesman. 1992. Joint U.S./U.K./Russian Statement on Biological Weapons. September 14.

Russian compliance is the only U.S. objective in pursuing the trilateral process. The trilateral process remains at an impasse, mired in mutual suspicion and recrimination.[22] ACDA Director Holum thus reported to the Fourth Review Conference of the BWC in December 1996 that "the challenge to demonstrate full eradication of that [Soviet] program still remains."[23]

Adding to these uncertainties is the sheer size of the former Soviet BW complex. For example, it is estimated that by the late 1970s, Biopreparat encompassed 50 research and development and production facilities and employed 100,000 people.[24] Russia is finding it difficult to maintain Biopreparat and other facilities financially, whatever their intended purpose may now be. Many elements of the complex still exist in some form, raising fears in the West that dangerous materials, equipment, and know-how could be misused or could leak to parties of proliferation concern. Encouraging Russia to reconfigure some facilities to carry out peaceful work on dangerous pathogens and to convert others to peaceful use not connected with dangerous pathogens is thus an important aspect of U.S. nonproliferation policy.

The CTR program and the ISTC expanded their efforts to include former BW facilities and specialists in 1994. During 1996 and 1997, a number of other U.S. government agencies began to show interest in cooperative programs with components of the former Soviet BW complex. (These programs are identified in Table E-1.) Like the ISTC projects, most of these activities support the redirection of former BW researchers and facilities to work on civilian problems not directly related to dangerous pathogens.

THE IMPORTANCE OF U.S.-RUSSIAN COOPERATION ON DANGEROUS PATHOGENS

The committee recognizes that Russia will continue to support legitimate research on dangerous pathogens, with a substantial portion probably concentrated in facilities of the former Soviet BW complex. The committee believes that it is in the best interests of the United States for American specialists to be actively engaged in collaborative research at these facilities. Such collaboration is important for two key reasons: (1) to provide a mechanism for increasing mutual assurance that activities related to dangerous pathogens are devoted to legitimate purposes and (2) to draw on the extensive Russian expertise in advancing the national and international knowledge base and public health capabilities related to prevention and control of dangerous infectious diseases.[25]

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[22] Dando and Pearson, op. cit., p. 108.

[23] U.S. ACDA, Washington, D.C. 1996. The Honorable John D. Holum, Director, Remarks to the Fourth Review Conference of the Biological Weapons Convention, Geneva, Switzerland, November 26. The head of the Russian delegation, Grigory Berdennikov, told the conference that the Russian Federation "adheres to all clauses of the convention and has never developed, produced, accumulated, or stored biological weapons" (Parrish, S. 1996. *Russia denies it has biological weapons.* OMRI Daily Digest, November 27). See also U.S. Arms Control and Disarmament Agency. 1996. *Threat Control Through Arms Control: Annual Report to Congress.* Washington, D.C.: U.S. ACDA, pp. 86-87.

[24] Rimmington, op. cit., p. 87. The estimate is based on translated Russian press reports and the authors' interviews with Biopreparat officials. Biopreparat officials told the committee that it currently has 40,000 employees, of whom approximately 1,000 are highly qualified scientists with specialized knowledge and skills relevant to dangerous pathogens.

[25] There is no evidence to support suspicions about U.S. noncompliance with the BWC. Based on the committee's experience in Russia, a number of Russians who will be key to successful implementation of the proposed *Pathogens Initiative*, nevertheless, harbor genuine suspicions about U.S. compliance with the BWC. The committee believes that it will thus be necessary to build the trust and confidence of the Russians over time; hence this report emphasizes the need for *mutual* assurance.

The five-year *Pathogens Initiative* and the subsequent Phase 2 model for sustained collaboration recommended in this report provide a framework for a more concerted effort for engaging the intellectual core of the former Soviet BW program. Although such collaboration should be effective in and of itself, the committee also believes that the proposed program must be linked to other U.S. government efforts to engage former Soviet BW scientists in collaborative research and public health activities extending beyond dangerous pathogens. In combination, these programs will promote the continued transition of former Soviet BW scientists into many areas of civilian research. In addition, by increasing linkages between the civilian and military sectors, transparency will increase, thereby further reducing the risk that collaborative research programs could contribute to illegal activities while enhancing the effects of scientific efforts.

In the committee's assessment, the benefits of carefully designed U.S.-Russian collaboration on research on dangerous pathogens—the focus of the *Pathogens Initiative*—far outweigh the risks, but the risks cannot and should not be ignored.

Transparency as a Response to Risk

The committee recognizes that even the most extensive collaboration between Russian and U.S. scientists will not provide incontrovertible assurance that all research activities on dangerous pathogens are in compliance with the BWC. No means has been identified to achieve such a standard. The committee is confident that there is little risk of abuse in the pilot projects in view of the transparency arrangements that include reciprocal on-site exchanges of project investigators. The committee has concluded that under the transparency arrangements described below, expanded cooperative activities can be carried out in a manner that ensures the risk of abuse of such a program is reduced to an acceptable level.

The expanded arrangements to enhance transparency envisioned for the *Pathogens Initiative* and its subsequent phase should include mutual agreement, on a project-by-project basis, as to activities that are legitimate; regular and agreed-upon access to facilities, personnel, and information; and a commitment to the principle that providing assurance is an active rather than a passive responsibility—for example, through regular reporting and consultation. Given inevitable dual-use concerns about research on dangerous pathogens, the committee believes that scientific collaboration with experts and facilities involved in BW programs must include all of these aspects of transparency. Moreover, for any collaborative project to be supported, its potential contributions to public health and U.S. national security objectives must be judged to outweigh the residual risk of abuse.

This level of transparency would be considerably beyond current practice. For example, the rules of access to facilities provided under the ISTC—20 days after proper notification—are not adequate for the kinds of dual-use technology represented by BW. These rules were negotiated in the context of international cooperation on nuclear issues—namely, access to the closed atomic cities of Russia—and were focused primarily on ISTC's financial oversight responsibilities (see Box 1-5). The committee believes, however, that these rules are very useful and represent the best that can be achieved within the ISTC context at present.

Box 1-5 ISTC Access Requirements for Individual Projects

- Identification in research proposal of all participants in a proposed project who have participated in biological defense activities, as well as identification of other participants
- Reports on project implementation, including quarterly technical progress reports, annual technical reports, and a final comprehensive report together with related financial reports
- With 20 days advance notice, access by financing party and its designees to all project activities and to complete information on facilities, equipment, documentation, information, data systems, materials, supplies, personnel, and services that are involved in the project
- Right of Russian institution to protect those portions of facilities not involved in the project
- Records and documentation maintained for possible audit for two years after completion of project and availability of personnel for interviews about the project during this period

Source: ISTC Statute, Article XVI, March 17, 1994, and ISTC procedures as of July 1997.

If adopted, the *Pathogens Initiative* will offer additional layers of protection against potential abuse of the projects by building stronger, more direct, and sustained ties between laboratories and researchers. By providing funds to permit U.S. researchers to visit and spend time in the laboratories of their Russian research collaborators, the *Pathogens Initiative* will provide broader and more frequent access—and hence confidence—than current ISTC arrangements can achieve.

1. Repeated visits to the same facilities in connection with a variety of projects will expand knowledge and insights beyond those that can be provided by the narrow ISTC requirements for individual visits.

2. As the *Pathogens Initiative* expands, it can be expected to provide access to new facilities and laboratories.

3. Sustained personal interactions among U.S. and Russian scientists involved in the joint research will provide insights beyond those required by ISTC.

4. Detailed understanding of problems encountered during the conduct of collaborative research will also provide new insights into Russian capabilities and programs.

The outcome of current negotiations to strengthen the BWC with a legally binding verification protocol could also influence the potential effectiveness of bilateral transparency arrangements. The current BWC confidence-building measures represent voluntary commitments that only a few countries regularly fulfill (see Box 1-1).[26] If the *Pathogens Initiative* is implemented in the context of a new protocol, risks will be further alleviated because this cooperative effort will be supported and complemented by the new verification arrangements. A situation without a protocol will be more difficult. In this instance the committee believes that it will be even more important to have the *Pathogens Initiative* as a key element of a coordinated U.S. government effort to fill the void.

Benefits

The benefits of U.S.-Russian collaboration on dangerous pathogens fall into four broad categories.

1. National security benefits

- Providing greater mutual confidence about compliance with the BWC than would otherwise be possible: As noted above, properly designed collaborative research projects can provide an important means for enhancing transparency: joint research, person-to-person contacts, regular exchanges of personnel, and direct access to facilities all promote transparency. Many defense scientists working in

[26] These countries include the United States, Russia, and the United Kingdom.

closed facilities have had little contact with civilian counterparts working on related problems.[27] Involving these scientists in research on public health problems could build bridges between military and civilian institutions and their personnel. Integrating them into international, as well as national, networks of researchers committed to the prevention and control of dangerous diseases should reinforce standards of ethics and social responsibility that counter the temptations of illegal activities. Providing opportunities for them to talk shop with colleagues and, as a result, to practice their trade and be valued for this contribution are strong incentives for complying with international norms.

- Reducing proliferation incentives: For several years, Russian scientists who possess extensive experience in handling pathogens with BW potential have left their institutes for new careers that promise better financial or scientific futures in Europe, the United States, and Israel.[28] Some of the remaining scientists may be tempting targets for states or terrorist groups in search of recruits or information on BW. Collaborative programs, with guaranteed paychecks and challenging research activities, can reduce the economic incentive for Russian specialists to respond to such recruitment efforts.

- Serving as a stepping stone to dismantlement opportunities: Collaboration on dangerous pathogens can help identify opportunities for joint dismantlement projects, another key CTR objective. Experienced researchers can provide guidance on the most effective use of facilities and on the removal or modification of research equipment no longer needed for military purposes. Research institutes also might provide introductions to other parts of the former BW complex, such as engineering and design facilities, where excess military-oriented equipment could be put to new types of peaceful use.

- Reconfiguring former Soviet BW-related activities: Severe cutbacks in funding for military programs have already led to a considerable redirection toward civilian activities of research and development that previously supported the Soviet BW program. However, large and diffuse research and development and standby production capabilities with BW potential remain in Russia. In the absence of alternative employment opportunities, defense scientists constitute a powerful lobby for maintaining facilities that are beyond Russia's national security requirements for defensive BW research. A substantial collaborative research program would provide new employment opportunities for many key scientists, thereby reducing pressures on the Russian government to invest in maintaining unnecessary facilities. Also, if such a collaborative program is designed to concentrate financial support at a limited number of the best Russian facilities, any weaker facilities–to the extent they remain viable–will have incentives to find work outside the area of dangerous pathogens, particularly in the private sector.

- Enhancing capabilities to combat bioterrorism: Both the United States and Russia are concerned about the growing threat of bioterrorism.[29] Expanded cooperation in basic research, epidemiology, diagnosis, and prophylaxis of diseases associated with dangerous pathogens can enhance the capabilities of both countries to identify and respond to emerging terrorist threats.

2. Public health benefits

- Improving understanding of the prevalence and characteristics of pathogens that pose threats to public health: The Soviet investment in BW-related research has resulted in a cadre of highly qualified scientists with unique knowledge about dangerous pathogens. Collaborative activity can provide the

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[27] Throughout this report the term defense scientists refers to scientists and engineers who participated in BW related activities before or after the disintegration of the Soviet Union in 1991. It is assumed that some defense scientists were engaged in activities prohibited by the 1972 Biological Weapons Convention and others were not. Unless otherwise stated, the emphasis in cooperation is on engaging those defense scientists who were most directly involved in research and development of dangerous pathogens with biological weapons potential.

[28] Rimmington, op. cit., p. 96.

[29] The threat of bioterrorism was raised on a number of occasions by Russian participants at the committee's workshop in Petrovo-Dalnyee.

United States with new insights into research capabilities, laboratory techniques, and knowledge that may not currently be known outside Russia.

- Strengthening capabilities to prevent, diagnose, and treat outbreaks of infectious diseases: Both countries have substantial capabilities in epidemiology and public health for monitoring outbreaks of diseases. Linking national capabilities through expanded cooperation can enhance global surveillance and improve epidemiologic investigations and responses to outbreaks of diseases.
- Enhancing international communications concerning disease trends and outbreaks: Strengthened communications links among individual investigators, research institutions, and government agencies can improve the capabilities of both countries to anticipate and respond to outbreaks of diseases and provide mechanisms to determine the source of outbreaks.

3. Economic benefits

- Improving the stability of Russian research institutes by increasing the commercial viability of their research products: Defense scientists with BW expertise are more likely to continue working on projects with promising economic futures, both for their institutes and for themselves, than to remain in place if they are offered only low-paying tasks with little future or very short-term technical challenges with uncertain long-term security. Each research product that achieves commercial viability is also a small contribution to Russia's transition to a market economy. At the same time, the reality is that Russian institutes have had great difficulty finding international or domestic markets for their products or finding partners who can help locate such markets. Some of the projects included in the collaborative program should help a few Russian institutes become more competitive commercially by focusing new attention on the importance of high-quality prototypes, strong quality-control systems, and well-developed marketing and distribution systems. Cooperation will provide opportunities for access to U.S. business and marketing skills in these and other areas.
- Leveraging limited national financial and human resources to serve national security and public health interests: Coordinated research activities in both countries on dangerous pathogens that pose current and potential health risks to the world's populations offer opportunities to combine limited financial and human resources in combatting dangerous infectious diseases.
- Providing new opportunities for the U.S. private sector to become more active in Russia: The current level of U.S. private-sector involvement in Russia in the development of vaccines, diagnostic devices, or other commercial commodities in the biomedical field is very low. Cooperation can lead to better appreciation of the capabilities of Russian specialists and provide easier access to Russian expertise and facilities. Coupled with appropriate commitments to respect intellectual property rights, such developments can increase the interest of the U.S. business community in investment, licensing arrangements, and expanded trade.

4. Scientific benefits

- Enhancing the base of fundamental knowledge of pathogenesis: A collaborative effort that engages Russian and U.S. scientists in fundamental science will provide opportunities for exploring new research avenues.
- Increasing the international availability of research results: Most Russian scientists cannot afford to subscribe to Western journals or attend scientific meetings in the West. On the other hand, U.S. scientists have a limited appreciation of the past accomplishments of Russian investigators because of a lack of English-language reports of their scientific findings. The proposed program to engage key Russian specialists in joint projects should significantly increase the exchange of information and knowledge between the two countries.

The Need for Coordination of U.S. Government Efforts

The U.S. government supports a growing array of efforts involving defense scientists (see Table E-1). In addition to the CTR and ISTC programs discussed previously, there are related projects of the U.S. Department of Energy (DOE) Initiatives for Proliferation Prevention, National Aeronautics and Space Administration, National Institutes of Health (including the Fogarty International Center), Civilian Research and Development Foundation, U.S. Department of Agriculture, and DOE's Chemical/Biological Non-Proliferation Program. At the highest level, the Gore-Chernomyrdin Commission has considered a few related programs through its three committees on health, science and technology, and defense conversion. To date, these activities have involved only limited engagement with the personnel and facilities of the former Soviet BW complex, but interest in such engagement appears to be growing.

CTR and ISTC now have more than five years of experience working with the defense scientists of Russia, but other U.S. organizations do not have comparable experience. As other programs undertake research activities with former BW scientists, systematic coordination among related programs is exceedingly important so that national security objectives are considered fully and that tax and customs exemptions with the Russian government are utilized whenever possible.[30] President Clinton created a special position, at the rank of ambassador, with the responsibility of coordinating these cooperation or assistance efforts.[31] Effective use of this or an alternative coordination mechanism is essential to ensure that the substantial potential benefits of cooperation with the former Soviet BW complex are realized and the risks that collaborative research efforts could contribute to illegal activities are minimized.

THE BLUEPRINT FOR COOPERATION

This chapter has provided the context and rationale for U.S.-Russian cooperation involving specialists and facilities of the former Soviet BW complex. Chapter 2 describes the initial NAS experience with a number of pilot projects designed to test the feasibility of such collaborative arrangements, while developing plans for long-term cooperation. This experience provided the basis for the five-year *Pathogens Initiative* outlined in Chapter 3. Chapter 4 describes a model for a subsequent sustained program of cooperation encompassing activities across a wider range of work on dangerous pathogens.

The framework for bilateral activity recommended in this report in time could become a basis for expanded cooperation among a number of key countries. Ultimately, enhanced international security and global health can be achieved only through broadly based multinational networks incorporating many of the elements stressed in the *Pathogens Initiative*.

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[30] Representative Floyd Spence. Letter to the editor. Washington Post, July 7, 1997.

[31] White House. 1995. Memorandum for the heads of executive departments and agencies on charter for special adviser to the president, April 4.

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Establishing the Basis for Long-Term Cooperation

This chapter describes the activities of the committee during fiscal year (FY) 1997 to develop the basis for long-term collaboration involving defense scientists working on dangerous pathogens. Insights gained during consultations with a large number of Russian specialists and lessons learned during the initiation of six pilot projects at two key Russian facilities are discussed. Then a policy and program framework is suggested for carrying out more ambitious programs that build on successful experiences to date.

IMPORTANCE OF RUSSIAN PARTICIPATION IN JOINT PLANNING

During the fall of 1996 and the spring of 1997, the committee undertook a number of activities in Russia to assess the opportunities for a long-term program of cooperation between U.S. and Russian specialists with special expertise in the epidemiology, prophylaxis, diagnosis, and therapy of diseases associated with dangerous pathogens. These activities were particularly important in initial assessments of the benefits that could be anticipated from such cooperation, as well as the challenges and costs of establishing appropriate arrangements. The committee gave special attention to the participation of Russian specialists who had been involved in the former Soviet biological weapons (BW) program.

To involve Russian specialists at a very early stage in the development of recommendations for a cooperative program, two complementary approaches were used:

1. Consultations were held with a range of Russian officials, managers of research institutions, and research scientists. The topics of interest included the general character of a long-term cooperative program, the availability of specialists and facilities to carry out a program, and the likely results of cooperation. An important purpose of the consultations was to help ensure that the committee's assessments of the technical basis for cooperation were authoritative and that proposed activities were realistic. Also, because the support of a number of Russian organizations will be an essential aspect of such a long-term cooperative program, the involvement of Russian officials and specialists from the planning stages was intended to give them a sense of genuine partnership in program development.

2. Pilot projects were initiated at two Russian facilities. These six projects are providing experience in the practical aspects of conducting joint projects, with most of the research activity carried out in Russia (see Box E-1 and Appendix E). At the same time, they are producing research results that, in and of themselves, are important. Also, they are making timely contributions at the scientist-to-scientist level to provide insights about the capabilities of the two countries in carrying out research on dangerous pathogens—insights that are critical for sustaining a broadly based long-term program of cooperation. Finally, funding by the Defense Department of the pilot projects recommended by the committee helped convince Russian colleagues that the committee's undertaking was a serious endeavor with strong backing from the U.S. government, thereby encouraging them to participate actively in planning the long-term program.

With this two-track approach, the committee quickly engaged a number of important Russian officials and defense scientists in its activities.

PLANNING FOR SUSTAINED COOPERATION IN THE LONG-TERM

The development of recommendations for long-term cooperation involved consultations with Russian colleagues through a variety of venues. Nine U.S. and sixteen Russian specialists took part in a roundtable hosted by Biopreparat in the Moscow suburb of Petrovo-Dalnyee in April 1997 to consider the general framework for cooperation. Specialists from Biopreparat and the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) joined public health-oriented researchers and other specialists to discuss the organizational framework, financial aspects, technical dimensions, and research themes for a cooperative program. A joint summary of the conclusions of the meeting can be found in Appendix G.

Discussions continued at a smaller follow-up meeting organized by the NAS committee in Moscow in June 1997, attended by representatives of Biopreparat and directors of several of its key research institutes. This meeting brought into sharper focus future project directions and approaches for joint planning and development of specific research activities. At that time, Biopreparat informed the committee that it was organizing a Russian working group to serve as the point of contact for future discussions of bilateral cooperation, with the invited membership listed in Box 2-1. If all invited members of the working group choose to participate, it will have an excellent composition for this purpose.

Box 2-1 The following organizations have been invited by Biopreparat to form the working group for future discussion of bilateral cooperation:

- Biopreparat
- President's Committee for Conventional Problems of Chemical and Biological Weapons
- Ministry of Defense
- Ministry of Health
- Ministry of Science and Technology
- Russian Academy of Sciences
- Russian Academy of Medical Sciences

Individual institutes invited include the following

- State Research Center for Virology and Biotechnology, "Vector" (Koltsovo)
- State Research Center for Applied Microbiology (Obolensk)
- Institute of Immunology (Lyubuchany)
- Institute for Biological Scientific Instrumentation (Moscow)
- Plague Research Institute, "Microb" (Saratov)
- Central Scientific Research Institute for Epidemiology (Moscow)

NOTE: Biopreparat officials have indicated that other organizations will be involved as appropriate.

The National Academy of Sciences (NAS) and International Science and Technology Center (ISTC) sponsored an international symposium in the Kirov region in June 1997, with ISTC taking the lead in the organization: 30 Russian scientists, joined by 14 American, 6 Japanese, and 3 European specialists, covered a wide range of topics of broad interest. Some of the Russian participants presented specific project proposals.

A number of biotechnology activities and facilities previously associated with the former Soviet BW program are located in and near Kirov, which is 1,000 km east of Moscow. The symposium and subsequent visits to various organizations in Kirov provided opportunities for initial discussions with local specialists and with experts from other parts of Russia about future cooperation. A brief report prepared at the meeting and a list of attendees are included in Appendix H. The facilities visited are listed in Appendix C.

In addition to the organized meetings and visits, committee members participated in a number of

informal discussions with Russian organizations and individual specialists, beginning in November 1996 and continuing into the summer of 1997. Among the most useful discussions were conversations between committee members and Russian scientists during visits to the Russian institutes where pilot projects have been established.

The comments of Russian colleagues underscored the importance of high-level support for a long-term program by the Russian government. Several Russian colleagues informed the Russian Defense Council of NAS interest in expanding bilateral cooperation, and Biopreparat representatives subsequently advised the committee that the council strongly supported the initiative.

Overall, interactions between committee members and Russian specialists provided valuable insights into Russian capabilities and activities. Russian colleagues were very sensitive to both national security considerations (e.g., maintaining security for pathogen strain banks and sensitive research findings that could be misused by terrorist groups) and scientific opportunities, and they offered many useful suggestions about future cooperation. They also indicated strong support for the types of recommendations included in this report.

An important exception to the success of these consultations, however, was the refusal of the Russian Ministry of Defense (MOD) to participate in discussions of cooperation. Biopreparat and other Russian officials offered two explanations for this reluctance. First, for political reasons the difficulties encountered in the trilateral discussions on BW-related issues made MOD unwilling to become involved in cooperative activities of interest to the committee. Second, MOD was undergoing a major reorganization and was initiating a substantial reduction in the size of the Russian armed forces; therefore, MOD officials were not in a position at that time to discuss international cooperation. Consequently, the committee received no direct indications of MOD views on future cooperation. However, in 1996, MOD and its research institutes participated actively in an ISTC-sponsored international workshop in Pokrov, northeast of Moscow, which indicated some flexibility in the long-standing policy of keeping laboratories isolated from foreign contacts. Also, in Kirov, committee members and staff met with representatives of several civilian organizations that involve specialists from the MOD research institute located in the city in their activities. These Russian colleagues appeared optimistic that in the future the institute will become interested in international cooperation. The Biopreparat invitation to MOD to participate in the working group, as indicated in Box 2-1, is also of interest.

Should MOD remain reluctant to participate in bilateral endeavors, a number of key Russian personnel and several very important facilities would not be involved in the *Pathogens Initiative* discussed in Chapter 3. However, the Biopreparat complex provided much of the critical research and development support for the Soviet program; thus, the committee has concluded that Biopreparat is sufficiently important to warrant a *Pathogens Initiative*. Effective bilateral cooperation with specialists from Biopreparat institutions, supplemented by specialists from institutes subordinate to other Russian organizations, would be a significant contribution to reducing the likelihood of proliferation and expanding research that supports public health goals.

INITIAL PILOT PROJECTS

With Russian colleagues, the committee developed the cooperative pilot projects at two Russian institutes that are identified in Box E-1 and described in more detail in Appendix I. DOD provided financial support of about $420,000 to the institutes and an additional $80,000 to U.S. collaborators to support travel and related expenses. The first six projects began in June 1997 and are scheduled for completion by September 1998. In July 1997, DOD transferred funds for the projects to the ISTC for prompt disbursal to Russian participants.

Encouraged by the progress achieved in implementing the six projects, DOD subsequently